IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of	:	
Wilk et al.	:	Art Unit: 1797
Serial No: 10/517,046	:	Examiner: Lessanework T. Seifu
Filed: 03 December 2004	:	Confirmation No. 1193

For: METHOD OF LUBRICATING AN INTERNAL COMBUSTION ENGINE AND IMPROVING THE EFFICIENCY OF THE EMISSIONS CONTROL SYSTEM OF THE ENGINE

DECLARATION OF PATRICK MOSIER UNDER 37 C.F.R. 1.132

VIA EFS
M/S RCE
Commissioner for Patents
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Sir:

I, Patrick Mosier, declare and say as follows:

(1) I received a Bachelor of Science degree from Purdue University in 1989. I completed and defended my PhD in Inorganic Chemistry from the University of Michigan in 1995. After several years of employment in the chemical industry, I joined Lubrizol in 2000. Initially, I was employed in Research and Development, primarily focusing on the development of new anti-wear agents. I joined the Engine Oils group in 2003 where I was responsible for identifying and formulating new anti-wear additives as well as developing new screening methods. In addition to this work, I am also the technology manager for Railroad Engine Oils. Since 2007, I have been a technology manager supporting base oil activities as well as managing intellectual property strategy

for Engine Oils. Based on the foregoing education and experience, I consider that I am a person of skill in the art relating to the inventions disclosed and claimed in the present application.

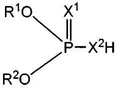
(2) I am thoroughly familiar with the invention disclosed and claimed in the above-identified application ("the present application"), and have read and understood the present application. I have reviewed the Office Actions from the U.S. Patent and Trademark Office (USPTO) in the present application.

(3) The present application discloses and includes claims drawn to a method of lubricating an internal combustion engine and improving the efficiency of the emissions control system of the engine, in which the emissions control system is equipped with a catalyst containing exhaust gas after treatment device. As is known, phosphorus in exhaust gas can be harmful to the catalyst in such an emissions control system. Thus, the industry has sought to reduce the phosphorus content of the lubricating oil compositions used in engines equipped with such catalyst-containing exhaust gas after treatment devices. This goal needs to be attained while at the same time providing adequate lubrication, which is a feature usually measured by the amount of wear experienced by moving engine parts lubricated with a given lubricating oil composition. As the inventors of the present invention found, when the phosphorus content is thus reduced, the lubricating function of the lubricating oil composition may be deleteriously affected, as reflected by increased wear. As stated in page 1 of the present application, the problem therefore is to provide adequate engine lubrication and at the same time reduce catalyst contamination.

(4) As stated in the present application, and as shown by the test results presented in the following, the present invention provides a solution addressing this

problem. The problem has been addressed by the present inventors' discovery that the volatility of the phosphorus can be decreased by increasing the average chain length of the alkyl groups on the compound (I) shown in the claims, while the durability, i.e., effectiveness of the lubricating function of the lubricating oil composition, as measured by wear tests, is maintained by including at least the specified content of short chain alkyl groups in the compound (I). To my knowledge, this combination has not been previously recognized as providing these combined benefits.

Specifically, as stated in the application and claims of the present application, the lubricating composition used in the disclosed and claimed method includes a base oil, an alkali or alkaline earth metal-containing detergent, a metal salt of one or more phosphorus-containing compounds represented by the formula (I),



(I)

in which X^1 and X^2 are either oxygen or sulfur, and R^1 and R^2 are hydrocarbyl groups, in which the average total number of carbon atoms in R^1 and R^2 for the one or more phosphorus-containing compounds is at least 10.4, and in which at least one of the R^1 and R^2 groups contains 4 or fewer carbon atoms and up to about 40 percent of all the R^1 and R^2 groups contain 4 or fewer carbon atoms, and an acylated nitrogen compound as specified, in which the phosphorus content of the lubricating oil composition is up to about 0.12% by weight. This combination of features provides both reduced phosphorus content in the exhaust gas and improved wear, as compared to similar lubricating oil compositions that have a different combination of R^1 and R^2 groups, not meeting the foregoing description. To repeat, to my knowledge this combination has not been previously recognized as providing these combined benefits and, based on my

experience, these combined benefits would not have been expected.

(5) Under my supervision, employees of the assignee of the present application have carried out a series of tests to assess the antiwear performance of lubricating oil compositions both in accordance with the present invention and not in accordance with the present invention. The results clearly show that only the lubricating oil compositions that fall within the description of the invention as set forth in claim 1 of the present application obtain the desired results.

(6) BENCH TESTING

In order to screen new candidates before running (expensive) engine tests, we utilize a Cameron Plint reciprocating rig. The rig is a TE77 High Frequency Friction Machine (Phoenix Tribology). While the exact test conditions are proprietary, they are similar to standard HFRR tests (ASTM D6079).

Typical samples are evaluated against a baseline formulation to provide a basis for comparison. These formulations are usually formulated as 5W-20 oils in Group II base oil (e.g. ExxonMobil EHC 45). Olefin copolymer Viscosity Index improvers (OCP VII) are used to blend multigrade oils. Test oils are summarized in Table 1, below:

(This space intentionally left blank.)

Table 1 – Oils tested in Cameron Plint

	%Oil	Ex. 1	Comparative Ex. 2	Comparative Ex. 3
EHC 45 (% as oil)		85	85	85.06
OCP VII	90	5	5	5
Hi TBN Ca Sulfonate	42	0.88	0.88	0.88
Lo TBN Ca Sulfonate	42	0.65	0.65	0.65
PIB succinimide detergent	45	5.1	5.1	5.1
Secondary ZDDP (A)	**9**	**0.15**		**0.6**
Secondary ZDDP (B)	**8**	**0.48**	**0.65**	
Ashless Antioxidant		2.2	2.2	2.2
Organic FM		0.1	0.1	0.1
Diluent Oil		0.44	0.42	0.41
%Phosphorus		0.056	0.055	0.062
%Sulfur		0.23	0.21	0.23
C3		16	0	60
C6		84	100	40
TOTAL C per Phosphorus		11.2	12	8.4

Notes:

(i) All component treat rates are on an oil diluted basis

(ii) Secondary ZDDP (A) is the same ZDDP utilized in Comparative Example C-1 of the patent application (60:40, isopropyl alcohol : methylpentylalcohol)

(iii) Secondary ZDDP (B) is the same ZDDP utilized in Example 1 of the patent application (100% methylpentylalcohol)

(iv) Ashless Antioxidant may include hindered phenol esters, alkylated diphenylamines, and/or sulfurized olefins

All three test oils were formulated identically except for the ZDDP. In this case, all of the ZDDPs were primary but employed different combinations of long and short alkyl chains to achieve the reduction in volatility while maintaining durability, as shown in Table 2, below:

Table 2 – Cameron Plint Results

	Ex. 1	Comp. Ex. 2	Comp. Ex. 3
Secondary ZDDP (A)	**0.15**		**0.6**
Secondary ZDDP (B)	**0.48**	**0.65**	
%Phosphorus	0.056	0.055	0.062
%Sulfur	0.23	0.21	0.23
C3	16	0	60
C6	84	100	40
TOTAL C per Phosphorus	**11.2**	**12**	**8.4**
Cameron-Plint Wear Test			
Load (N)	150	150	150
Duration (min)	75	75	75
Frequency (Hz)	20	20	20
Wear Scar (microns)	**301**	**642**	**368***
Coefficient Of Friction	0.103	0.106	0.141*
PEI (mg P/L oil)**	**15**		**39**

* average of 5 runs

**PEI data was collected on similar formulations per application.

As evidenced by the data in Table 2, Example 1, which has an average of over 11 carbon atoms per phosphorus AND contains some C3 alkyl chains, shows antiwear on a par with comparative Example 3, which has significantly more of the low molecular weight alkyl chains. However, it is the low molecular weight alkyl chain alcohols which contribute significantly to phosphorus volatility, so that the lubricating oil composition of Example 3 would have a significantly higher phosphorus volatility. See, in this regard, Table II of the present application, which shows that ZDDP having low total carbon number exhibits higher P volatility. Example 2, which has a total carbon number similar to Example 1, but contains no low molecular weight alkyl chain alcohols according to the present invention, shows significantly reduced wear protection. The lubricating oil composition of Example 2 would be expected to provide reduced phosphorus volatility, but this improvement would be at the expense of the wear performance. Based on my

experience and as a person skilled in the art, I estimate that the PEI measurement for Comp. Ex. 2 in Table 2 would not be significantly, if any, higher than the PEI of 15 measured for the inventive Example 1 in Table 2.

The wear benefit of the present invention is better illustrated graphically where the deviation from expected wear performance is quite significant (Figure 1).

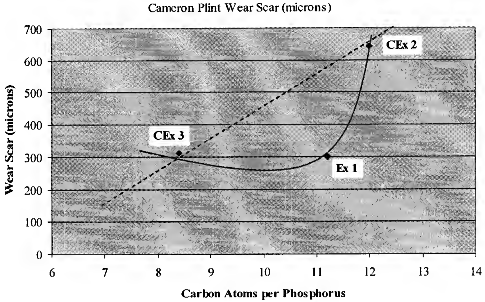


Figure 1

(7) Engine Testing

The Sequence IVA remains the standard test for determining valve train wear in gasoline fired engines and is expected to remain a part of the next North American upgrade (GF-5). Test formulations are based on those screened in bench testing. However, as is typically the case, there are minor differences from test oil to test oil in order to maximize information gathering. While the oils tested here do have small differences between them, those differences do not impact the wear performance in this

test. The significant difference between Example 4 and the Comparative Examples 5 and 6 is in the ZDDP alkyl group content, and the unexpected wear results obtained from the Example 4 composition in accordance with the invention as compared to the Comparative Examples.

Table 3 - Formulations tested in Seq. IVA

	%Oil	Ex. 4	Comparative Ex. 5	Comparative Ex. 6
Vis Grade		5W-20	5W-30*	5W-20
EHC 45 (% as oil)		84.8	80	83.9
OCP VII	90	5	8	4.9
Hi TBN Ca Sulfonate	42	0.88	0.88	0.88
Lo TBN Ca Sulfonate	42	0.65	0.65	0.65
PIBsuccinimide detergent	45	5.1	5.1	5.1
Secondary ZDDP (A)	**9**	**0.15**	**0.48**	
Secondary ZDDP (B)	**8**	**0.48**		**0.56**
Ashless Antioxidant		2.2	3.5	3.1
Molybdenum AO	50	0.14		
Organic FM		0.1	0.5	0.48
Diluent Oil		0.49	0.89	0.44
%Phosphorus		**0.056**	**0.052**	**0.049**
%Sulfur		0.23	0.24	0.22
C3		16	60	0
C6		84	40	100
TOTAL C per Phosphorus		**11.2**	**8.4**	**12**
Average Cam Wear		**19.11**	**21.7**	**41.81**

*5W-30 is essentially 5W-20 with more polymer added

As shown in Table 3, and consistent with the Cameron-Plint bench tests described above, the oil utilizing the higher average carbon chain ZDDP performs as well as the lower average carbon chain. Ordinarily, the higher the number of carbon

atoms per P, the worse the wear, as shown in Comparative Example 6. To the contrary, the present invention obtains low average cam wear with a higher number of carbon atoms per P.

(8) As shown by the foregoing test results, a lubricating oil composition in accordance with the present invention, as described, e.g., in claim 1 of the present application, provides the long-sought reduction in phosphorus volatility together with improved lubrication as measured by the wear protection, when compared with similar lubricating oil compositions that do not meet the limitations specified for the present invention.

I, Patrick Mosier, hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued therefrom.

Respectfully submitted,

08/21/2008
Date

Patrick Mosier